(12) UK Patent Application (19) GB (11) 2 226 490 (13) A

(43) Date of A publication 04.07.1990

(21) Application No 8925936.0

(22) Date of filing 16.11.1989

(30) Priority data
(31) 8826864 (32) 17.11.1988 (33) GB

(71) Applicant
Woodville Polymer Engineering Limited

(Incorporated in the United Kingdom)

Alton Road, Ross-on-Wye, Herefordshire, HR9 5NF, United Kingdom

(72) Inventor
John Michael Devereux De Le Pena

(74) Agent and/or Address for Service
J.K. Hogg
Dowty Group Services Ltd, Patent Dept., Arle Court, Cheltenham, Glos., GL51 0TP, United Kingdom

(51) INT CL[4]
A62B 17/04 18/04

(52) UK CL (Edition K)
A3V V11K V16
A5T TCX
F1V VCS V200
H1N NAX N616 N700 N707 N844 N855
U1S S1128

(56) Documents cited
None

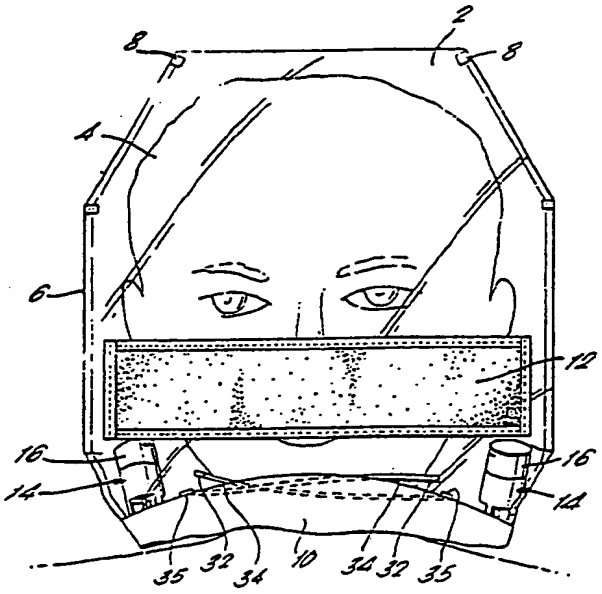
(58) Field of search
UK CL (Edition J) A3V, A5T TCX
INT CL[4] A62B
Online databases: WPI, CLAIMS

AP

(54) Protective hoods

(57) A protective hood for use either in fire emergencies or as protection against escaping irritant gases in an industrial environment, is provided which is light, transportable, easily stored and easy to use. The hood comprises a bag-like head covering (2) of heat-resistant, and/or gas impermeable sheet material, the bag being transparent over at least the area which, in use, falls in front of the eyes of the wearer. Filter pad or pads (12) are positioned to cover the nose and mouth of the wearer and are attached in such manner that the wearer can inhale therethrough. Sealing means (10) are provided at the mouth of the bag to create a seal around the neck of the wearer when donned. The hood is fitted with at least one motor-driven fan (14) to assist in removal of accumulating exhaled gases within the hood and with power means (18) to drive the motor, the fan and the power means being arranged in the hood in such manner that power is supplied to the motor automatically via switch (60, 64, Fig. 6 or 20, 28, 32, Fig. 2) when the hood is unpacked or first donned. Suitabl fans and impeller blading (Figs. 4 & 5) are described.

FIG. 1.



GB 2 226 490 A

IMPROVEMENTS IN AND RELATING TO PROTECTIVE HOODS

The invention relates to a protective hood which is capable of protecting the wearer from the effects of heat and smoke and noxious fumes in the event of a fire or from the effects of toxic or irritant gases such as might escape during a leakage or spillage in, for example, a laboratory, chemical plant or factory.

In the case of a fire in an aircraft, ship, hotel or other public building it is essential that members of the public are protected from the effects of heat, smoke and toxic fumes within the shortest possible time following the outbreak of fire. Likewise in the case of an industrial accident, the workers need to be protected from escaping irritant gases immediately any leakage or spillage occurs. It is important to remember that when faced with such an emergency situation there is a tendency, in most people, to panic which inhibits logical thought. Furthermore in the case of an emergency incident involving the general public, such as for example, an aircraft fire, elderly people or handicapped persons may be present whose reactions will be slower than those

of the young and able-bodied. For thes reasons the donning of a protective hood must be a rapid and very simple, self evident act which does not involve the assimilation of complicated instructions by the wearer.

It is also necessary, particularly in the case of protective hoods for use on aircraft or ships that the hood be light foldable and easily stored in a small space.

This requirement for simplicity of donning and ease of storage is generally met by the 'bag' type of hood which is pulled over the head in one action and is donnable in any orientation while still providing filters against gases and smoke particles across the nose and mouth of the wearer. In hoods of this type the wearer inhales air through the filter which absorbs toxic fumes or irritant gases and blocks smoke particles. Exhaled gases, CO_2 and water vapour, leave the hood, either by passing back through the filter or by a passage through specially provided exhaust vents or valves. Unfortunately, however there is always a considerable amount of dead-space within

the protective hood, especially if the wearer is small, in which exhaled gases accumulate and are not easily expelled. This accumulation results in an increasing carbon dioxide level which can cause distress to the wearer as well as 'misting up' and a generally unpleasant environment.

It is well-known in the art of powered respiratory equipment to assist air supply to a mask or hood by providing a fan unit either upstream or downstream of a filter in the air inlet of the hood. In all cases however waste gases are simply exhausted through vents. The fan units tend to be large, heavy and cumbersome, often being required to be strapped to the back of a wearer of protruding prominently from the front of the hood or mask. Such units are only really suitable with a hood of solid construction. Further the power may be supplied either by large batteries or from the mains depending on the application and the wearer will be required to operate a switch to turn on the power supply to the fan. In an emergency the wearer may be in a state of shock or panic and therefore not have the presence of mind to operate a fan in this manner.

Respiratory apparatus of the above type is thus totally unsuitable for use in an emergency situation especially by untrained persons. Furthermore equipment of this sort of bulky construction is impractical for storage and transportation.

A protective hood in accordance with the invention comprises a bag-like head covering of a heat-resistant, and/or gas-impermeable sheet material, the bag being transparent over at least the area which in use falls in front of the eyes of the wearer and having one or more filter pads positioned to cover the nose and mouth of the wearer, and attached in such manner that the wearer can inhale therethrough, sealing means being provided at the mouth of the bag to create a seal around the neck of the wearer when donned wherein the hood is fitted with at least one motor-driven fan, which is adapted to facilitate removal of accumulating exhaled gases within the hood, while preventing the ingress of smoke and fumes therethrough and power means to drive the motor, the fan and power means being arranged in the hood in such manner that power is supplied to

the motor automatically when the hood is first donned.

Preferably, electrical switch means is connected in a circuit with the fan and power means and is adapted to be operated automatically by the action of a wearer in unpacking the hood or donning it so that the power means is connected to the fan. The switch means may be a reed switch provided with a small magnetic strip which is located adjacent to the switch so as to hold the switch in an open condition when the hood is packed ready for use, and which is automatically removed from the vicinity of the switch and causes the switch to close when the hood is unpacked for donning by the wearer. For example, the reed switch and magnetic strip may be secured to different portions of the hood which are folded together when the hood is packed, but which are moved apart as the hood is unpacked.

Alternatively, electrical contacts of the motor may be separated by a strip of insulating material to prevent a connection being made with the power means before the hood is donned, the insulating

strip b ing attached to the hood in such a way that, on donning of the hood, the strip is removed from the contacts, the connection between the power means and the motor thus being made to instantly drive the fan. The insulating strip may, for example, be one end of a tape of a non-elastic material, such as, for example, PVC, the other end of the tape being attached to the hood in a tensioned manner at a point distant from the insulating strip so that the stretching of the hood which is necessary on donning results in the removal of the strip from the contacts. Preferably the other end of the tape to that which provides the insulating strip is attached to the neck sealing means.

The fan is therefore operated automatically by the action of unpacking and/or donning the hood so there is no need for the wearer to assimilate any instructions for switching on the fan and yet he or she is instantaneously provided with the full protective benefit of the hood. The venting of the waste gases by the fan assures comfort for the wearer for the duration of the emergency.

The ingress of smoke and fumes through the fan itself is preferably prevented by a one-way exhalation valve which closes when the wearer inhales and opens when the wearer exhales. The exhalation valve functions in this manner even when the motor is not operating and thus in the event of failure of the motor, for any reason, smoke and fumes cannot enter the protective hood via the fan unit.

Preferably the power means is one or more lithium batteries having very small dimensions, for example, about 10mm long by 10mm in diameter. The fan and motor are preferably combined in a single cylindrical unit also having small dimensions. The unit may be between 40 to 60mm in length and 18 to 25mm in diameter. The small size of the combined motor and fan unit and the batteries allows them to be easily incorporated into a 'bag-type' protective hood without unduly increasing the weight, bulkiness or ability to be folded and stored in a small space. In fact it is preferable for the hood to be fitted with two fan and motor units there being a separate power supply for each one.

Despite the small size, the fan may be capable of both axial and centrifugal air-flow and have a total air/waste gas through-put of 70 litres per minute.

In accordance with another aspect of the invention a method of exhausting exhaled gases from a protective hood of the bag-like type is provided which method comprises fitting the bag with at least one motor-driven fan and with power means to drive the motor, the fan being adapted to remove gases from the inside of the hood to the atmosphere while preventing the ingress of smoke and fumes therethrough wherein the fan and the power means are arranged in the hood in such manner that power is supplied to the motor automatically when the hood is first donned.

To achieve the necessary characteristics of lightness, foldability and ease of use and storage in a protective hood in accordance with the invention the bag-like head covering is preferably made from a film material, preferably transparent, which, depending on the particular application of the hood, has chemical and/or heat resistance.

The hood may be constructed from more than one suitable material. Particularly suitable films are those made from polyimide, polycarbonate, polyurethane, polyvinyl chloride, polyester and high density polyethylene. The sheet-material of the hood may be additionally coated with a heat-reflective coating such as gold and/or nickel and aluminium.

The sealing means at the mouth of the bag which provides a seal around the neck of the wearer is preferably a flexible diaphragm of any suitable elastic, substantially gas impermeable sheet material such as, for example, latex rubber, silicon rubber, butyl rubber or neoprene. A particularly preferred diaphragm material is a flame-retardant polyurethane. The filter pad or pads are preferably multi-layered and of a soft flexible material to allow the hood to be easily folded and stored. A suitable construction might be a first or outer layer of a flame-proof, spark-resistant material such as, for example, non-activated charcoal cloth, a second layer of an electrostatically charged polycarbonate non-woven mat, a third layer of an 'activated' charcoal

cloth and a fourth or inner layer of a polyurethane foam loaded with 'active' charcoal granules. Additionally the hood may be provided with catalyst packs to convert carbon monoxide to carbon dioxide, which is then exhausted by the fan.

The protective hoods in accordance with the invention may be made available for use in aircraft, ships, hotels and other public buildings, or incorporated into an emergency pack for use in such places in the event of fire. Further they may also be made available in laboratories, chemical plants and factories for use by workers in the event of fire or as protection against escaping irritant gases such as for example chlorine, ammonia, hydrogen sulphide and sulphur dioxide.

The invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a front view of a protective hood in accordance with the invention when in use,

Figure 2 is an enlarged schematic view of the mechanism for operating the fan,

Figure 3 is a longitudinal cross-section through the combined fan and motor unit,

Figure 4 is a top view of a stator blade showing the degree of curvature,

Figure 5 is a part sectional elevation of the fan rotor and blades,

Figure 6 is a front view of a protective hood according to an alternative embodiment of the invention, and

Figure 7 is a longitudinal cross-section through the fan and motor unit used in the protective hood of Figure 6.

Referring to Figure 1 the protective hood comprises a bag-like head covering 2 made of a transparent film which can be pulled over the head of the wearer 4. The bag is usually constructed from front and back panels which are joined at

seams 6 and are reinforced by tapes 8.

The mouth of the bag is fitted with a diaphragm 10 of an elastic, gas impermeable sheet material which can be easily stretched to pass over the head to don the hood but then contracts to provide a seal around the wearer's neck. A multi-layer filter pad 12 is attached across the bag 2 in a position such that it is in alignment with the nose and mouth of the wearer when the hood is donned. Apertures (not shown) are provided in the film across the area where the filter is attached so that air can pass through the filter into the hood when the wearer inhales. The filter pad 12 may be annular, stretching around the whole circumference of the bag 2 or, two or more pads may be arranged around the hood in such a way that the hood can be safely donned in any orientation.

Two cylindrical combined fan and motor units 14 are vertically positioned at the bottom, on either side of the hood, the end of the units in which the fan is disposed protruding through the flexible diaphragm 10. Each fan and motor unit 14 is provided with a compartment 16 which contains a

lithium battery.

The connection between the motor and the battery is seen schematically in Figure 2. The battery 18 has its positive terminal 20 uppermost and its negative terminal 22 resting on the positive terminal 24 of the motor 26. Provision for the connection between the negative terminal 30 of the motor 26 and positive terminal 20 of the battery 18 is made by means of an extending wire 28. However, before the hood is used the positive terminal 20 and the end of the wire 28 are separated by a strip of insulating material 32 so that power is supplied to the motor. The insulating strip 32 is one end of a tape of non-elastic material 34 (see Figure 1). The other end of this tape 34 is attached to the flexible diaphragm 10 and 35 on the opposite side of the hood to the fan and motor unit 14 with which it is connected. Thus on stretching the flexible diaphragm 10 to don the hood each of the tapes 34 must be pulled in a direction away from their respective fans and being of a non-elastic material, the effect is to pull the insulating strip 32 from between the positive terminals 20 of

the batteries and the end of wires 28 which are connected to the negative terminals 30 of the two motors 26. Thus power is instantaneously supplied to the motors 26 to drive the fans as the hood is donned.

The construction of the fan 36 is seen more clearly in Figures 3, 4 and 5. Referring first to Figure 3 the motor 26 and the fan 36 are disposed in a common cylindrical housing 38. The housing 38 extends above the motor 26 to provide a compartment 16 (see Figure 2) for incorporating the battery or batteries 18. The fan 36 comprises a stator insert 40 which is attached to the housing 38 by means of eight curved stator blades 42. The dimensions of the stator blade sections vary linearly between the root and the tip. The precise curvature of the stator blades is shown in Figure 4.

The fan 36 further comprises a rotor 44 which is mounted on the motor spindle 46. The rotor 44 bears nine curved fan blades 48 (see Figure 5) the blade section of each one, as with the stator blades, varying linearly between the root and the

tip. The blades 48 are arranged such that th 40% chord point of each blade lies in the same radial plane. The fan blade sections have a semicircular leading edge and are a constant thickness between this edge and the 70% chord point.

When the fan rotor 44 is driven by motor 26, waste gases are drawn from the hood through intake window 50 and blown by the rotor blades 48 through the stator blades 42 to the exterior of the hood taking both an axial and centrifugal path. The back-flow of noxious gases through the fan into the hood is prevented by means of a one-way exhalation valve 52 which moves from the open position shown at 52b to the closed position shown at 52a in Figure 3 when the wearer inhales. The valve 52 functions in this manner even when the motor is not operating.

It is envisaged that the fan components and housing will be injection moulded of a suitably light material such as for example, glass-filled nylon to minimise the final weight of the protective hood.

An alternative embodiment of the invention is illustrated in Figures 6 and 7 in which a combined fan and motor unit 54 incorporates a battery 58 and a reed switch 60 so that the switch connects the battery to the motor 62 under the control of a magnetic strip 64. The magnetic strip 64 is connected via a short length of flexible tape 66 to a point on the hood 68 just above a corner of the filter pad 70 and above the fan and motor unit 54 so that when the hood is folded on itself into a pack ready for use, the magnetic strip 64 lies adjacent to the unit 54 and can be located inside the housing 72 of the unit 54 against the reed switch 60 and held lightly in place thereon by adhesive. In this packed state the magnetic strip 64 serves to hold the reed switch 60 in an open position in which it disconnects the battery 58 from the motor 62. However, when the hood is unfolded to be donned by a user, the magnetic strip 64 is automatically pulled away from switch 60 causing the switch to close and connect the battery 58 to the motor 62. The motor 62 is therefore powered by the battery 58 and drives the fan rotor 74 to extract waste gases from the hood.

The combined fan and motor unit 54 is illustrated in Figure 7. The fan rotor 74 is similar to the fan rotor 44 in Figure 3 except that it is mounted on top of the motor 62 with the motor housed within the stator 76 downstream of the rotor 74. The battery 58 is supported in a case 78 that is attached beneath the stator 76 within the outer housing 72. The negative terminal 80 of the battery 58 is connected to the positive terminal 82 of the motor 62, and the positive terminal 84 of the battery is connected via the reed switch 60 to the negative terminal 86 of the motor, the reed switch being located within the case 78 and on the side of the battery 58. The magnetic strip 64 when it is located adjacent to the switch 60 in the packed state of the hood, is attached lightly by adhesive to the outer surface of the case 78 within the housing 72. A one-way exhalation valve 88 is provided between the stator 76 and the housing 72 so as to operate in the same manner as the valve 52 in Figure 3.

As previously stated the fan and motor unit for use in accordance with this invention can each provide an air/waste gas through-put of up to

70 litres per minute. The average r spiratory volume of a sedentary adult is about 8 litres/min and rises to 75 to 80 litres/min during moderate to high activity and even to 100 litres/min at very high work rates. Thus a single fan unit could provide adequate waste gas clearance for most emergency situations and therefore the provision of two fans merely provides extra capacity to ensure the comfort of the wearer during either very high activity or prolonged wear.

CLAIMS

1. A protective hood comprising a bag-like head covering of a heat-resistant, and/or gas impermeable sheet material, said bag being transparent over at least the area which in use falls in front of the eyes of the wearer and having one or more filter pads positioned to cover the nose and mouth of the wearer and attached in such manner that the wearer can inhale therethrough, sealing means being provided at the mouth of the bag to create a seal around the neck of the wearer when donned wherein said hood is fitted with at least one motor-driven fan which is adapted to facilitate removal of accumulating exhaled gases from the hood while preventing the ingress of smoke and gases therethrough and power means to drive said motor, the fan and the power means being arranged in the hood in such manner that power is supplied to the motor automatically when the hood is first donned.

2. A protective hood as claimed in claim 1 in which electrical switch means is provided which is adapted to connect the power means to the fan by the action of the hood being unpacked or donned by

a wearer.

3. A protective hood as claimed in claim 2 in which the electrical switch means is adapted to be operated by operating means which is connected to the hood and is cooperable with the switch means before the hood is donned and is automatically separated from the switch means when the hood is unpacked or donned by a wearer.

4. A protective hood as claimed in claim 3 in which the switch means comprises a reed switch and the operating means comprises magnetic means which holds the reed switch open when the hood is packed ready to be used.

5. A protective hood as claimed in claim 3 wherein the switch means comprises electrical contacts on the motor and the operating means comprises a strip of insulating material that separates the electrical contacts of the motor to prevent a connection being made with the power means before the hood is donned, said strip of insulating material being attached to the hood in such manner that on donning of the hood the strip

is removed from the contacts, the connection between the power means and the motor thus being made to instantly drive the fan.

6. A protective hood as claimed in claim 5 wherein the strip of insulating material is one end of a tape of a non-elastic material, the other end of said tape being attached to the hood in a tensioned manner at a point distant from the insulating sheath so that stretching of the hood which is necessary on donning results in the removal of the insulating strip from the contacts.

7. A protective hood as claimed in claim 6 wherein the other end of the tape to the insulating strip is attached to the neck sealing means.

8. A protective hood as claimed in any preceding claims wherein the ingress of smoke and fumes through the fan is prevented by a one-way exhalation valve which closes when the wearer inhales and opens when the wearer exhales.

9. A protective hood as claimed in any preceding

claim wherein the power means is at least one lithium battery being approximately 10mm in diameter and approximately 10mm long.

10. A protective hood as claimed in any preceding claim wherein the motor and the fan are within a single cylindrical unit having a length of between 40 to 60mm and a diameter of between 18 and 25mm.

11. A protective hood as claimed in any preceding claim wherein the fan is adapted for combined axial and centrifugal flow.

12. A protective hood as claimed in any preceding claim wherein the fan has an air/waste gas through-put of 70 litres per minute.

13. A protective hood as claimed in any preceding claim wherein the fan comprises a stationary stator bearing eight curved stator blades and a rotor mounted on a motor spindle, said rotor bearing nine curved fan blades.

14. A protective hood as claimed in claim 13 wherein the dimensions of both the curved fan

blade and stator blade sections vary linearly between root and tip.

15. A protective hood as claimed in claim 14 wherein the curved fan blades are arranged such that the 40% chord point of each blade lies in the same radial plane.

16. A protective hood as claimed in claim 15 wherein each of the fan blade sections are constant thickness between a semi-circular leading edge and the 70% chord point.

17. A protective hood as claimed in any one of the preceding claims which is provided with two motor driven fans.

18. A protective hood as claimed in any preceding claim wherein the bag-like head covering is made from a transparent film material selected from polyimide, polycarbonate, polyurethane, polyvinyl chloride, polyester and high density polyethylene.

19. A protective hood as claimed in any preceding claim wherein the sealing means is a flexible

diaphragm made from latex rubber, silicon rubb r, butyl rubber or neoprene or flame-retardant polyurethane.

20. A protective hood as claimed in claim 5 wherein the insulating strip is one end of a non-elastic tape the other end of said tape being attached to the sealing means.

21. A protective hood as claimed in any preceding claim wherein the filter pads are multi-layered and of a soft, flexible construction.

22. A protective hood substantially as described herein with reference to the accompanying drawings.

23. An emergency pack whenever comprising a protective hood as claimed in any preceding claim.

24. A method of exhausting exhaled gases from a protective hood of the bag-like type comprising fitting said hood with at least one motor-driven fan and power means to drive said motor, said fan being adapted to remove gases from the inside of

the hood to the atmosphere while preventing the ingress of smoke and gases therethrough, the fan and the power means being arranged in the hood in such manner that power is supplied to the motor automatically when the hood is first donned.

25. A method as claimed in claim 24 in which electrical switch means is provided which is adapted to connect the power means to the fan by the action of the hood being unpacked or donned by a wearer.

26. A protective hood as claimed in claim 25 in which the electrical switch means is adapted to be operated by operating means which is connected to the hood and is cooperable with the switch means before the hood is donned and is automatically separated from the switch means when the hood is unpacked or donned by a wearer.

27. A protective hood as claimed in claim 26 in which the switch means comprises a reed switch and the operating means comprises magnetic means which holds the reed switch open when the hood is packed ready to be used.

28. A method as claimed in claim 26 wherein the switch means comprises electrical contacts on the motor and the operating means comprises a strip of insulating material that separates the electrical contacts of the motor to prevent a connection being made with the power means before the hood is donned, said insulating strip being attached to the hood in such manner that on donning of the hood the insulating strip is removed from the contacts, the connection between the power means and the motor thus being made to instantly drive the fan.

29. A method as claimed in claim 28 wherein the strip of insulating material is one end of a tape of a non-elastic material, the other end of said tape being attached to the hood in a tensioned manner at a point distant from the insulating strip so that stretching of the hood which is necessary on donning results in the removal of the insulating strip from the contacts.

30. A method as claimed in any one of claims 24 to 29 comprising use of a motor driven fan substantially as herein described.

Published 1980 at The Patent Office, State House, 66/71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office. [illegible], St. Mary Cray, Orpington, Kent BR5 3RD. Printed by Multiplex techniques ltd, St Mary Cray, Kent. Con. 1/87

FIG. 1.

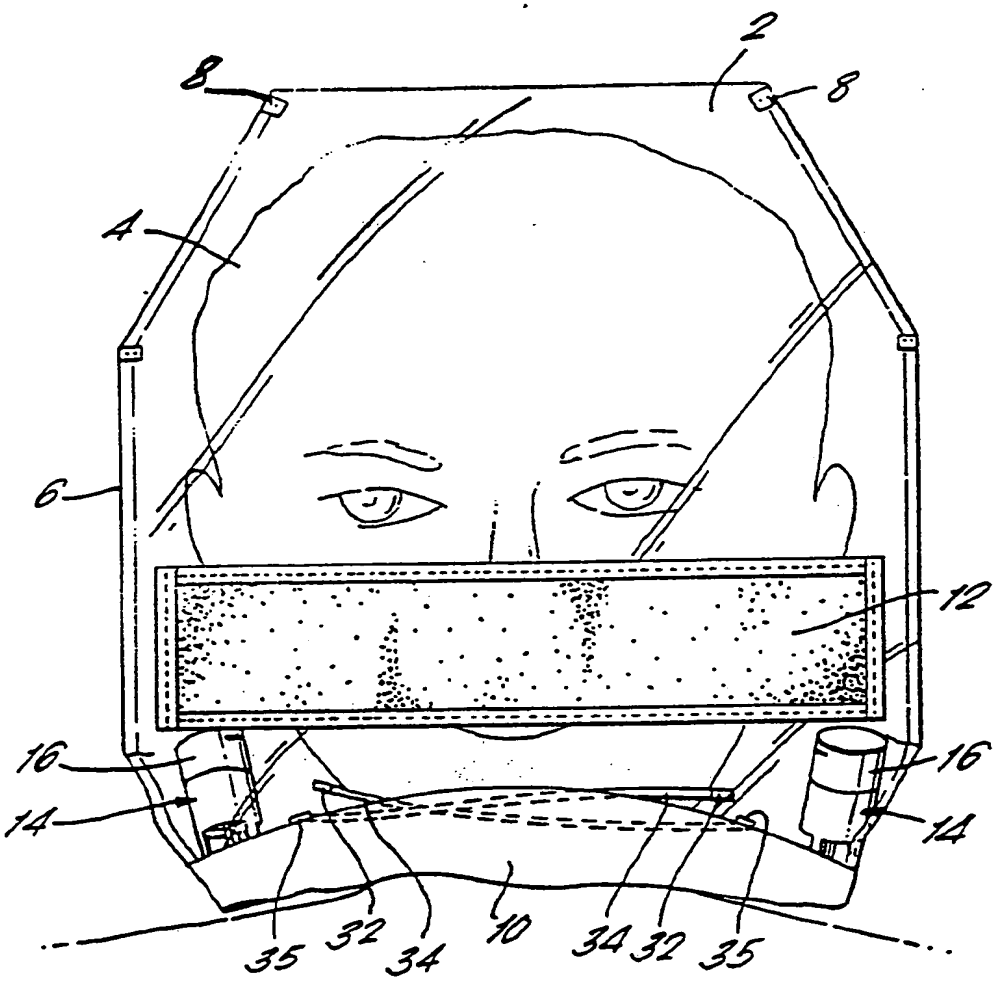


FIG. 2.

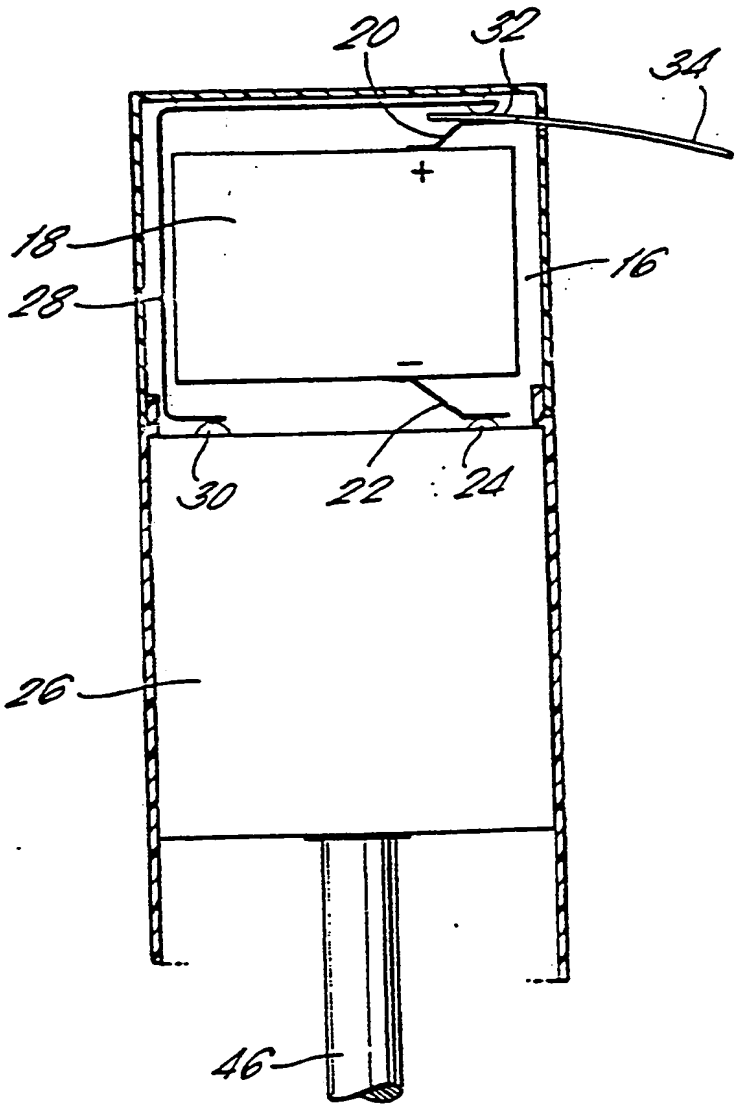


FIG. 3.

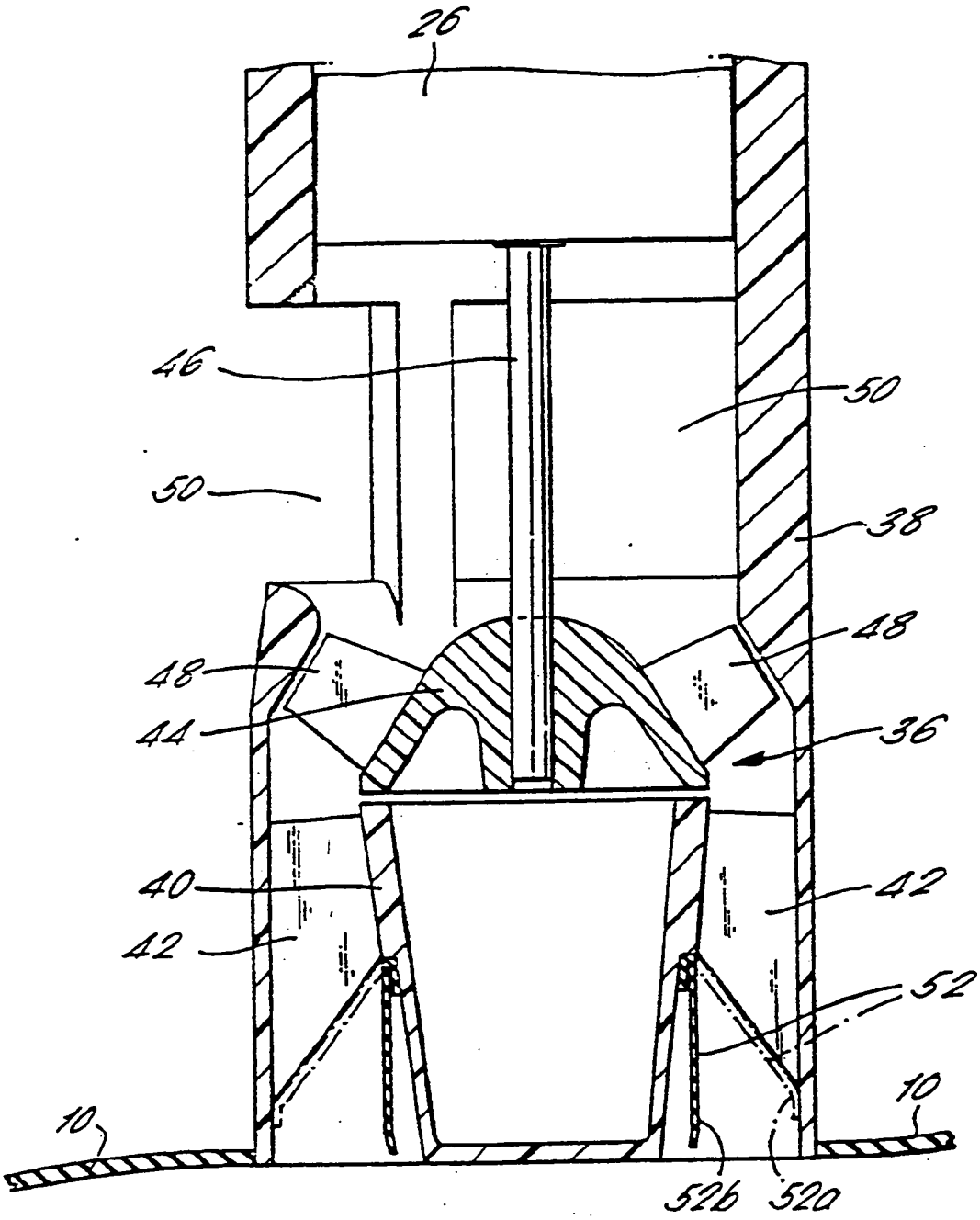


FIG. 4.

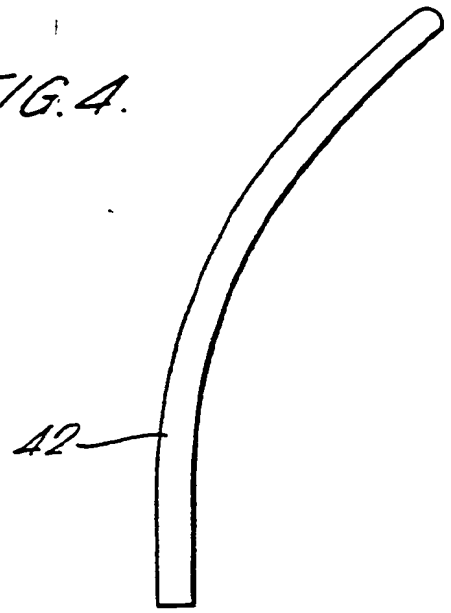
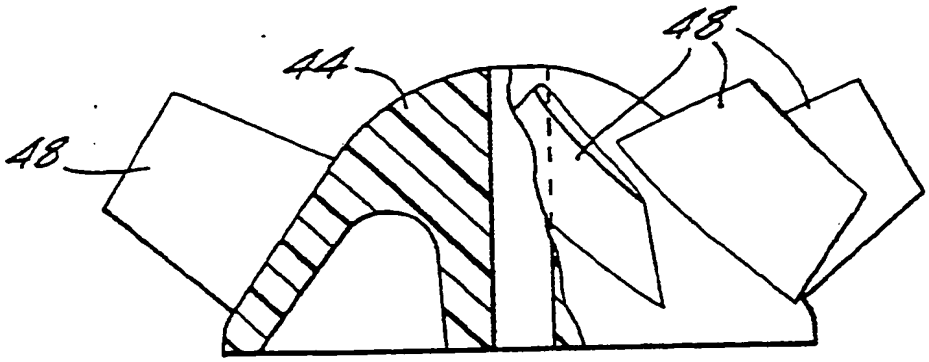


FIG. 5.



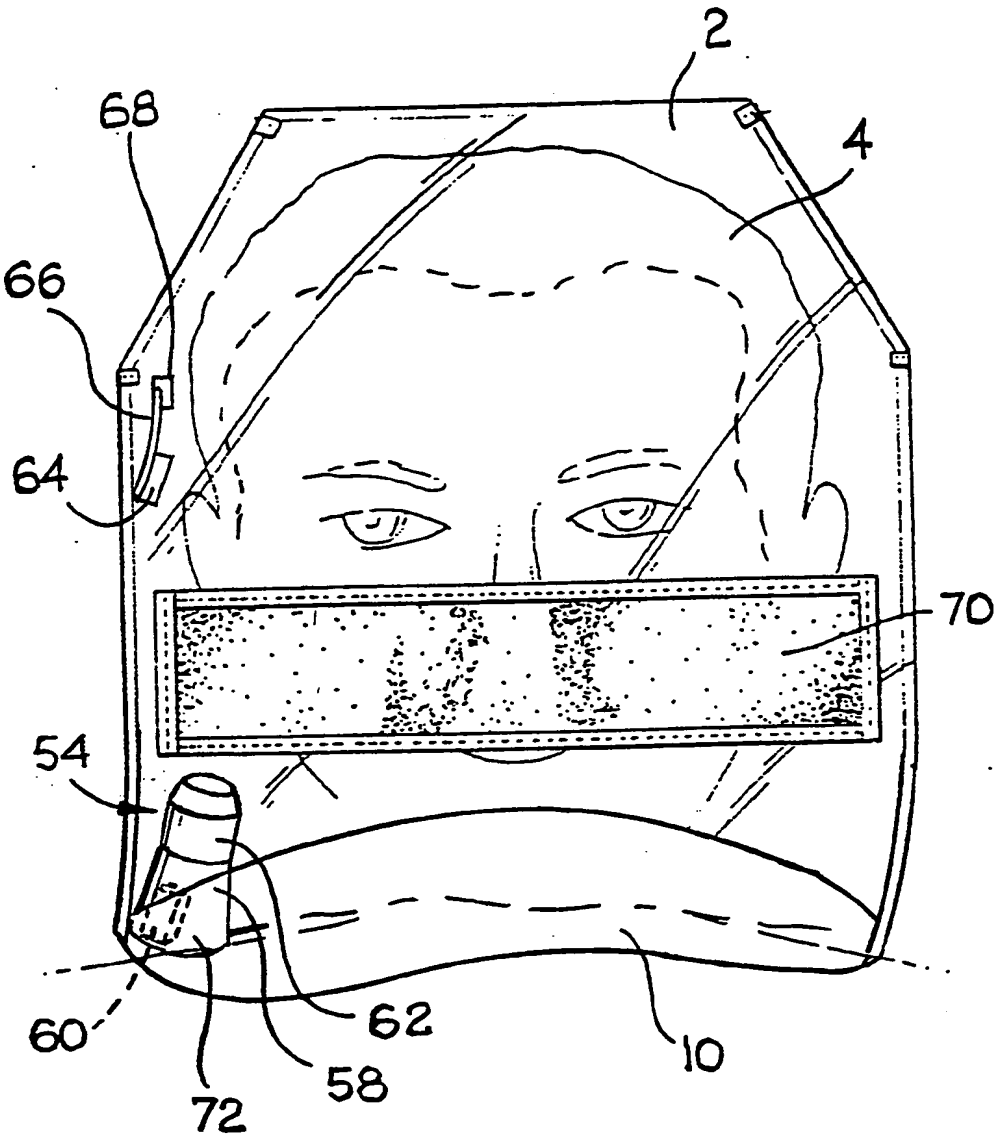


FIG.6

FIG. 7.